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JULY 1, 1952 TO JUNE 30, 1953

ENVIRONMENTAL HEALTH CENTER, CINCINNATI, OHIO

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Activities of the Environmental Health Center in Cincinnati, later renamed the Robert A. Taft Sanitary Engineering Center, are reviewed. Research and development areas include methodology, air pollution, water pollution, water supply, waste disposal, and food sanitation. Field surveys and technical services are described for water pollution surveys related to radioactive wastes, stream surveys, analytical services, and consulting services. Methods for disseminating the research findings include publications, verbal presentations, and the training program. Rederences are included.

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ANNUAL REPORT

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OF THE

ENVIRONMENTAL HEALTH CENTER

July 1, 1952 To June 30, 1953

U.S. DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
CINCINNATI, OHIO

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ANNUAL REPORT

OF THE

ENVIRONMENTAL HEALTH CENTER

JULY 1, 1952 - JUNE 30, 1953

* * * *

The year's activity at the Environmental Health Center was marked by a number of significant program changes. Among these was the activation of a project for the appraisal of environmental health research. This project is designed to provide assistance to the scientific research staff in evaluating methods and results of current research and in planning new research studies. A second project inaugurated early in the year was the study of methods for detecting toxins and toxic microorganisms of importance in food processing. These studies are directed toward the development of rapid and accurate techniques for detection and identification of bacterial toxins in foods and the determination of conditions affecting toxin development. Such techniques will provide a basis for formulating safe handling procedures in food producing, distributing, and dispensing establishments. At the close of the year, experimental studies of the pollution and purification of shellfish in northern coastal waters had been completed and the transfer of the Shellfish Sanitation Laboratory Studies to Pensacola, Florida, was in process. Experimental studies of Gulf Coast shellfish will be undertaken at that location. The end of the year also brought to a close

two and one-half years of field work on the study of the effects of radioactive wastes on the Columbia River. The temporary laboratory facilities established for this work, at Richland, Washington, were closed down. The report of this study will provide comprehensive data on the pollutional effects of reactor cooler water discharges from the Hanford Works on water uses of the Columbia River, including the effects on the biological population of the river.

Early plans contemplated that the new Environmental Health Center laboratory facility would be ready for occupancy and in use by the end of June, 1953. However, the schedule has had to be revised because of delays in the final stages of building construction and in installation of new laboratory equipment. Consolidation of the various existing facilities in Cincinnati is expected early in the fiscal year 1954.

RESEARCH AND DEVELOPMENT

The research program of the Center is directed toward (1) development of new methods and procedures for use in the field of sanitation and water pollution control, (2) better understanding of the phenomena associated with health hazards of the environment, and their control, and (3) critical evaluation of conventional methods of sanitary control.

Methodology

Methodology research as included in this report is concerned with the study and development of new and improved techniques of broad applicability to one or more of the programs of the Center. During the year, increased

emphasis was given to the development of methods for the identification of microorganisms and chemical substances.

Special studies were initiated on the adaptation of tissue cultures from various animal species for the investigation of sanitation practices as related to the occurrence of infectious hepatitis virus. From intensive cytopathologic, histochemical and serologic studies on cultured cells, both noninfected and infected with the virus, it is expected that a specific diagnostic test may be developed. Tissue cultures from human fetal and rabbit livers, rabbit fibroblasts, human fibroblasts, Earle's pure strain mouse liver cells No. 1469, and Hela strain of human carcinoma cells are under continuous cultivation. Procedures for the preparation of extracts of feces from humans supposedly normal and from others diagnosed as having infectious hepatitis have been devised.

Further improvements have been made in the development of differential media for the enumeration of coliform organisms in water, air and milk by membrane filter procedures. This work also has included coordination of an APHA sponsored study in ten collaborating laboratories, of the use of the membrane filter technique, to determine its feasibility for designation as a tentative standard method for the bacteriological examination of water.

For the rapid detection and identification of microorganisms, the use of infra-red absorption spectrophotometry has shown promise. Differences in the organic chemical composition of bacterial cells are sufficient to permit differentiation between individual bacterial species. Detailed studies have been made of storage polysaccharides and capsular polysaccharides

which are important sources of the chemical variations in the composition of bacterial cells. These studies have thrown much light on the causes of variation in the infra-red spectra of bacteria which represent the summation of absorptions due to proteins, carbohydrates, nucleic acids, lipids, and crystalloids.

Emphasis has been placed on the development of a continuous indicating and recording instrument for dissolved oxygen in water. Evaluation is being made of the relative advantages of colorimetric methods, polarographic methods, and oxygen stripping methods for this purpose.

Developmental work has been carried out on methods of analysis for specific components in water and waste samples, including cyanide, phenol, ammonia, aliphatic hydrocarbons, and threshhold odor tests. The carbon filter adsorption technique developed at the Center is a new and promising procedure for collecting and concentrating trace quantities of organic materials from water or other fluids. The qualitative and quantitative determination of specific organic constituents in the environment is fundamental to studies of treatment processes for their removal or control. Factors affecting the adsorption and elution of organics from the carbon filter are being subjected to detailed study in order to obtain maximum benefit from the use of this technique. The technique has been used on a semi-quantitative experimental basis in the study of taste and odors in water supplies and in tracing organic pollution to its source.

The study of the occurrence and role of fungi in environmental health has been vigorously pursued. Media for the cultivation of fungi are being evaluated from the standpoint of a) maximum production of fungi, and b)

maximum inhibition of bacteria. Many molds have shown bright, colorful, natural fluorescence under ultra violet light. This characteristic is being studied further to supplement ease of identification of individual species.

Air Pollution

Program objectives with respect to air pollution research have been necessarily limited. With the authorized transfer of full responsibility for air pollution control activities to the Center on July 1, 1953, primary attention in recent months has been given to program planning.

A critical exploratory review of available information on the public health aspects of community air pollution has been undertaken to appraise the nature and extent of effects arising among population groups subjected to various atmospheric conditions. The review is aimed at (1) recognizing important problems requiring further definition, (2) planning research projects to develop or adapt suitable methodology and apply it to the study of air pollution in relation to health and well being, and (3) estimating the kind and magnitude of laboratory and field investigations for which future programming will be needed.

During the year studies on development and evaluation procedures for the enumeration of microorganisms in air have been continued. Mobile air sampling equipment has been assembled. Rapid detection procedures using the membrane filter have been compared with the use of conventional selective agar media by plating the Shipe sampler collection fluid and by

exposure in the Sieve sampler. Sample collections have been made at a number of sources including the vicinity of a trickling filter sewage treatment plant. Some 104 pure cultures of bacteria together with cultures of yeasts, molds, and fungi derived from the air sampling are being studied and classified as to generic characteristics. The relative efficiency and usefulness of a variety of collection devices has been determined.

A radioactivity survey of the dust, air, rain and snow in the atmosphere over Cincinnati has been carried out since the first of March. A monitoring station consisting of a continuous dust sampler and continuous beta-gamma monitor has been operated. Since March 19, 1953, the second day after the start of the most recent series of Nevada atomic bomb tests, general level of alpha activity has remained the same. Rain samples have shown a persistent many fold increase in beta activity above normal background. Measurements of the radioactive decay rate on samples are being made. This is a supplemental activity to the Public Health Service fallout studies which were conducted in Nevada, and in which five of the Center staff members participated.

Associated studies have been made at the request of the Utah Department of Health and the Communicable Disease Center, into the cause of substantial mortality among sheep grazing in southwest Utah and southeast Nevada. The results of these studies show significant exposure of the animals to radiation, particularly as evidenced by radio-iodine in the thyroid tissues; however, the data neither confirm nor deny the possibility

that the mortality was due to fall-out of fission products.

Water Pollution

Research with respect to water pollution has been directed primarily at obtaining an understanding of (1) the importance of aquatic organisms in natural purification processes, (2) the effects of pollutants on fish life, and (3) the persistence of viral organisms and organic chemical pollutants in surface waters.

Ecological studies were directed toward the attainment of more adequate understanding of the role and value of aquatic organisms in the natural purification processes in streams of moderate size, and in a better definition of organisms indicative of pollution. Studies on Lytle Creek have indicated that sewage pollution has resulted in the growth of significantly larger and more numerous creek chubs at all downstream points at which fish could exist. These fish are more tolerant to pollution than bass and other game fish.

Experimental studies of the influence of pH on the toxicity of the nickelo-cyanide complex to fish were completed. The studies show that toxicity of the complex increases well over a thousand fold as the pH decreases from 8.0 to 6.5. A comprehensive critical review of literature on the toxicity of metallic salts to fish was completed.

Studies of the survival of Coxsackie virus indicated that in stored sewage at 20°C., there is marked reduction in the amount of virus present after 20 days, and no virus could be detected on the 61st day of storage. At temperatures of 6-8°C, inactivation of the virus was less rapid.

Inactivation of the virus in Ohio River water at 20°C was approximately three times as rapid, while autoclaving of the river water destroyed its virus-inactivating properties. Control studies with distilled water indicated that the virus could still be detected in water stored at 6-8°C for 142 days.

The Coxsackie virus is quite resistant to a variety of agents. Penicillin, streptomycin, chloromycetin, viscosin, 1% Roccal, and 5% Lysol have been found to have little effect on the virus.

Studies have been continued on the persistence of particular organic compounds in surface waters. Lignin, in various industrial forms, is discharged into receiving streams as a waste product of pulp and paper making operations. It was found to be very stable under normal conditions with approximately 50% of an initial dose of 10 ppm persisting after 22 weeks of observation in Ohio River water at 22°C in the absence of light. On the other hand, neutral hydrocarbons, including motor oil, showed substantial oxidation in the presence of fresh sewage.

Water Supply

Program objectives on water supply research were aimed at the evaluation and study of (1) methods of removing radioactive materials from water, (2) survival of pathogenic fungi in water, and (3) methods for control of algal growths.

Detailed experimental work on both a laboratory and pilot plant scale was carried out at the Oak Ridge National Laboratory on the efficiency of removal of radioactive materials from water by conventional water treatment processes. Completed studies were made with water solutions

containing several mixed fission product wastes and 22 individual radioisotopes. Treatment processes evaluated were conventional coagulation and sedimentation, filtration through various media, ion exchange, lime-soda ash softening, phosphate coagulation, addition of clay, excess lime-soda ash treatment, and addition of metallic dusts. The conventional treatment processes used by most municipal waterworks are of limited effectiveness in removing radioactive contaminants.

The results of preliminary studies on the survival of Histoplasma capsulatum in water have shown that, under the conditions of experiment in sterilized Cincinnati tap water and sterilized Ohio River water, stored at 5°C, 20°C, and 37°C, yeast cells and spores can survive and even multiply for at least 40 days.

It has been demonstrated that purified suspension of Coxsackie virus in water can be inactivated by chlorine. Inactivation times are dependent on temperature, hydrogen ion concentration, and chlorine concentrations. In general, 7 to 46 times as much free chlorine is needed to achieve comparable kills of Coxsackie virus than to kill E. coli cells.

Studies of algal growths as related to water supplies were intensified during the year. Colored drawings of algae selected according to their relative importance in water supplies have been made preparatory to publication of a manual for identification of algae.

Fifty different chemicals have been screened for their algacidal properties. Tests against 31 cultures of algae were made for some of the more promising algacides at concentrations covering a range of 64 to .004 ppm. The algacidal effectiveness of the chemicals tested varies considerably from

one species to another.

Waste Disposal

Waste disposal research has been concentrated on (1) evaluations of waste characteristics from industry and methods of treating industrial, municipal, and individual household wastes, and (2) study of new methods of treating wastes.

Comprehensive industrial waste studies were completed at a petroleum refinery plant, a chemical plant producing the ingredients for synthetic rubber production, a kraft pulp and paper mill, and a plant engaged in the destructive distillation of seasoned pine wood. In each instance the sources, volumes, characteristics, and available methods of treatment of component wastes were studied and potential methods for control and reduction of the wastes was explored.

During the year industrial waste guides for the use of state control officials and technical industrial personnel were prepared for:

Blast Furnace Wastes of the Steel Industry

Steel Rolling Mill Wastes of the Steel Industry

Wood Naval Stores Wastes

An evaluation study of the direct recirculation of a high rate trickling filter was made at a sewage treatment plant in Newberry, South Carolina. Results indicated that the effluent from this plant was equal to or better than that which might be expected from a conventional plant of this general type, thus offering possibility of design economy for future municipal installations.

Study of the application of biochemical processes to the treatment of radioactive wastes was continued both in cooperation with the Atomic Energy Commission at Los Alamos, New Mexico, and at Cincinnati, Ohio. In a study of the behavior of phosphorus ^{32} in a simulated laboratory trickling filter plant, only 20% of the radioactivity was removed. A new unit is being devised to improve the simulated plant.

Field and laboratory studies on individual household sewage disposal systems were substantially completed during the year. The chemical quality of the waste water can be a significant factor in soil clogging. In particular, high sodium concentrations have been demonstrated to cause such clogging. Studies were made of the effects of an anionic detergent containing 40% sodium alkyl aryl sulfonate as the active agent on a full scale septic tank. Results indicated that this detergent, applied in the concentration to be expected from a normal family wash day use, would have no deleterious effect on tank digestion of the quality of the effluent.

An evaluation study was made of a grinder type toilet for household use employing a recirculation system based upon aerobic principles. The model studied proved to be unsatisfactory over a 23 day experimental operation period.

Food Sanitation

Food sanitation research as used in this report includes (1) development and evaluation of methods for detecting microorganisms and toxins in milk, food, shellfish, and shellfish growing waters, and (2) understanding of the physical, chemical, and biological mechanisms involved in the growth of microorganisms in foods and in methods for controlling such growth.

A project was initiated on the development of methods for the detection of toxins and toxin producing microorganisms important in food poisoning. Staphylococcal culture filtrates were prepared and their enterotoxigenic potency established by animal tests. Intravenous injection in cats of 2.5 ml equivalent of toxic strains of non-dialysable culture filtrates produced vomiting in less than one hour, whereas similar injection of a non-toxic strain did not cause vomiting.

Studies were completed on the relative survival of coliforms and salmonella in shellfish and sea water in northeastern coastal waters at Woods Hole, Massachusetts. In June, the Shellfish Sanitation Laboratory was moved to Pensacola, Florida, to extend the research studies to conditions in the warmer Gulf coast waters.

Analysis of the variability of results of the current standard laboratory procedure for the direct microscopic bacterial count in milk has shown that the count is subject to large variation due to differences among observers in ability to distinguish bacterial clumps. Some individuals appear to vary greatly in their discriminating ability from one film to another. Others, however, reveal no more variation in counts on successive films than would be expected on the basis of a purely random distribution of bacteria over a film. Until the human error in examining films is considerably reduced, the count will remain greatly lacking in precision, regardless of any refinements in mechanical technique which may be introduced.

A quantitative spectrophotometric phosphatase method based on the new Scharer Modified Laboratory test has been developed for the study of the inactivation of phosphatase at temperatures lower than 143°F. Such studies

are aimed at development of procedures for detecting heated milk and admixture of raw and pasteurized milk.

Many natural waters have exhibited marked interference with the bactericidal effectiveness of quaternary ammonium compounds used in the treatment of eating and drinking utensils. This has limited the acceptability of such compounds for use in eating places and food handling and processing establishments. Laboratory results have indicated that the presence of bicarbonate salts of certain metals may be a major factor causing such interference. A series of four field studies using waters of decidedly different chemical composition have been conducted to check this preliminary observation and further work is being done on this problem.

FIELD SURVEYS AND TECHNICAL SERVICES

The field surveys and technical services program of the Center is concerned with fact finding on problems of primary interest in the local geographical areas effected. However, the results obtained and the field survey methods employed, are in many instances, of broad interest. This activity includes special engineering and mobile laboratory field studies, technical consultation services, and laboratory analytical services.

Water Pollution Surveys Related to Radioactive Wastes

Two field studies conducted by the Center have been concerned with the effects of radioactive wastes on streams. One study covered the background conditions on the Savannah River prior to discharge of radioactive wastes from the AEC Savannah River Plant. The other, on the Columbia River, was concerned with observable effects of radioactivity on a stream which

had been receiving reactor cooling waters from the Hanford Works for several years.

In the Savannah River Study a comprehensive picture of the river water quality characteristics including background radioactivity present both in the water and in the biota was obtained. Special surveys included study of the effect on the river of the impoundment which will follow completion of the Clark Hill Reservoir, determination of the effect of the discharge of sewage and industrial waste into the river water to be used by the Savannah River Plant, and study of the biology of economically important aquatic life in the river. Field work on the Savannah River Study was suspended early in the year pending completion and operation of the AEC Savannah River Plant. The study will be resumed to determine the effect of the Plant waste discharges on river water quality after full scale operations are in progress.

The primary objectives of the Columbia River Studies project were to determine (1) the behavior and effect of radioactivity and (2) the effect of impoundments on the biological and other characteristics of the Columbia River in particular, and surface streams in general. Field work on this project, initiated in early 1951, was completed in June, 1953.

Preliminary findings indicate that radioactivity levels are nearly constant during periods of constant flows, assuming no changes in the quantities and concentrations of waste discharges. Activity values for plankton depend mainly upon the values for water. The concentrations studied seemed to have little or no effect on the plankton organisms

themselves. Attached filamentous algae also concentrate activity but not as readily as free floating plankton. The radioactivity in bottom organisms appeared to depend upon metabolic rates, as well as upon concentrations in the water.

Seasonal variations in activity levels of fish were found to be quite large, and appeared to depend mainly upon metabolic rates. Species not feeding in these waters were found to have very low levels of activity, irrespective of the season. Examination of the individual parts of adult fish showed highest activity levels in the scale, liver, bone, sex organs, kidney, and stomach contents, with much lower concentrations in the skin and muscle.

A complete report on these studies is now in preparation.

Other Stream Surveys

Stream surveys associated with Public Health Service participation with other State and Federal agencies concerned with water and land resource development have been conducted. Mobile laboratories and technical teams have worked in the Arkansas-White-Red River and New York-New England areas to determine river water quality characteristics and sources of pollution. The following streams have been studied:

Arkansas River	Sand Springs, Oklahoma to Webbers Falls, Oklahoma
Arkansas River	Little Rock, Arkansas to Pine Bluff, Arkansas

Ouachita River	Arkadelphia, Arkansas to Richardson's Ferry, Arkansas
Ouachita River	Camden, Arkansas to Columbia, Louisiana
Black River	Port Leyden, New York to Lake Ontario
St. John River	Frenchville, Maine to Grand Falls, New Brunswick
Pemegewasset River	North Woodstock, New Hampshire to Franklin, New Hampshire

Boundary water stream surveys were conducted for the International Joint Commission in connection with its program for abatement of pollution in the waters between the United States and Canada. In the Detroit, Michigan, area five surveys of industrial plant wastes were made by a mobile laboratory team to determine the characteristics of liquid wastes being discharged. Studies of the raw water supplies at Mt. Clemens and Wyandotte, Michigan, were also made to determine chlorine demand, phenol concentration, and other organic chemicals present.

The report on pollution sources and the sanitary quality of tributaries to the Niagara River and the east end of Lake Erie was completed and forwarded to the International Joint Commission and to the New York State Department of Health.

Analytical Services

The Center continued to assist Federal, State, and local health agencies upon their request for aid on direct laboratory analytical services concerned with unusual problems and for review of sanitation laboratory practices.

In cooperation with the Arkansas State Board of Health, a study was initiated to provide reference service for evaluating the performance of State sanitary chemistry laboratories. Essentially the procedure involves preparation and distribution of portions of a prepared sample and specification of methods to be employed by cooperating laboratories. Parallel chemical determinations are made in the cooperating laboratories and at the Center for comparison of techniques. To date, this pilot project has proved most successful and close similarity in the results on individual determinations has been secured. Similar services of this type are being offered to other States.

Consultative reviews of laboratory practice in the examination of water, milk, and food were made in 33 sanitation laboratories in 24 States. The requirements of APHA Standard Methods, PHS Drinking Water Standards (1946), and PHS Milk Ordinance and Code were used as the basis for the evaluation.

In connection with a large fish kill at Pickwick Reservoir, bioassays were made to determine the toxicity to fish of wastes from the Tennessee Valley Authority Fertilizer Plant. The effluent from the plant and some bottom materials from the receiving stream, Pond Creek, tributary to the reservoir, were found to be toxic. Reservoir bottom samples were not toxic during the investigation.

Toxicity bioassays on fish were also made with wastes from the Armour Fertilizer Works at Bartow, Florida, at the request of the River Basin Engineer concerned and on aircraft cleaning materials for the Air Force at Wright Field.

Following a large fire at an industrial warehouse in Clarksburg, West Virginia, emergency assistance was rendered to the City with respect to possible toxicity of the public water supply as a result of drainage of released chemicals from the warehouse to the public water supply source.

Assays were made for gross alpha and gross beta radioactivity in samples of well water from the vicinity of Grants, New Mexico, and water and sewage samples from the city of Fort Worth, Texas, for the State and local health agencies concerned.

Consulting Services

Special consultative services on a wide variety of technical problems were given to Federal, State, and local agencies concerned with sanitation and water pollution control. A few representative problems handled are mentioned in the following paragraphs.

Technical assistance was given to the Texas Department of Health in connection with radioactive waste control problems associated with the Consolidated Vultee Aircraft Corporation installation at Fort Worth, Texas.

Similar assistance was given to the South Carolina State Health Department on procedures and techniques for surveying radiation producing machines, particularly shoe-fitting fluoroscopes.

At the request of the University of Florida, a review was made of the needs for development of the recently established Department of Bacteriology. The completed report covered the requirements for personnel, equipment, working space, funds, and curricula for the conduct of a combined training and research program to meet university-wide needs in microbiology.

A review of milk laboratory activities of the U. S. Navy Preventive Medicine Unit No. 2 at Norfolk, Virginia, was made at the request of the Fifth Naval District.

Investigations of aquatic life in Paddy's Run and the Great Miami River in the vicinity of the Fernald Plant at Cincinnati were completed for the Atomic Energy Commission. Representative samples of different species of fish were sent to the AEC New York Office.

At the request of the Colorado State Health Department technical assistance was furnished to the State and Great Western Sugar Company technologists on special analytical studies required to determine the efficiency of an experimental settling and aeration field for treatment of residual wastes from a straight house beet sugar factory.

Several investigations were made into the causes of fish kills in streams. Difficulties with respect to soil absorption systems for fringe area housing development individual sewage disposal works were investigated in the State of Florida.

DISSEMINATION OF RESEARCH FINDINGS

The results of investigative work at the Center are brought to the attention of professional workers in the field of environmental health by two primary methods. First, staff specialists participate on technical committees of national scientific associations; they give addresses to professional and scientific gatherings; and their findings are printed in special reports issued by the Center and in the technical press. Second, a special program of short training courses is given for State and local health agency personnel and other professional workers

concerned with the field of sanitation and radiological health.

Publications and Verbal Presentations

Staff members gave 85 talks, lectures, and discussions on technical subjects related to the research program of the Center at meetings of professional and academic groups throughout the country.

Thirty (30) scientific papers were published in the technical press during the year and twenty (20) special reports on completed projects were issued for distribution to professional workers in the field of environmental health. (See Appendix).

Training Program

The Center training program in advanced sanitation and radiological health was well attended during the year. There was a notable increase in the attendance of industry technical representatives in the courses which in the past have been attended almost exclusively by State or local health and water pollution control agency personnel.

Several new courses were presented for the first time, including an advanced course in radiological health for industrial hygiene personnel, a course in food sanitation, three short courses in the analysis of metals in industrial wastes, fluoride analysis, household sewage disposal systems, and a special course in radiological health for staff radiology residents at Cincinnati hospitals.

The 24 formal training courses conducted at Cincinnati, Ohio, during the year are shown in the accompanying table. It is of interest to comment that 35 states and 4 foreign countries were represented among the trainees in the different courses.

FORMAL TRAINING COURSES CONDUCTED AT
ENVIRONMENTAL HEALTH CENTER
JULY 1, 1952 TO JUNE 30, 1953

* * * *

DATE	DURATION OF COURSE (EQUIVALENT DAYS)	TITLE	TOTAL ENROLLMENT	REPRESENTATION				
				INSTITUTIONS	STATE & LOCAL	INDUSTRIAL	FEDERAL AGENCIES	FOREIGN COUNTRIES
Sept.10-Jan.14	10	Basic Radiological Health Kettering Lab. Personnel	8	7		1		
Oct. 6-17	10	Basic Radiological Health Training	12		6	2	4	
Oct. 13-24	10	Examination of Polluted Waters and Industrial Waste	12		2	9	1	
Oct.16-Mar.1	3	Advanced Course in Statistical Methods	10				10	
Oct.20-31	10	Intermediate Course Radiological Health	12		3	4	4	1
Oct.28-31	4	Membrane Filter in Bacteriological Analysis of Water	13		9	1	3	
Nov.11-14	4	Membrane Filter in Bacteriological Analysis of Water	9		5	2	2	
Nov.20-21	2	Radiation Symposium for Physicians	17	6	2	5	4	
Dec. 1-12	10	Advanced Training for Sanitary Chemists in Water Pollution Investigations	14		1	12	1	
Jan.12-16	5	Advanced Training in Bacteriological Examination of Water	14		8	1	2	3
Jan.19-23	5	Advanced Training in Bacteriological Examination of Milk and Dairy Products	14		11		1	2
Jan.19-30	10	Basic Radiological Health Training	18		5	1	12	
Jan.26-30	5	Feed Sanitation Training	14		11	1	1	1
Feb. 2-13	10	Intermediate Course - Radiological Health	14		5		8	1
Feb.6-Mar.10	5	Radiation Hygiene for Physicians	12	12				

DATE	DURATION OF COURSE (EQUIVALENT DAYS)	TITLE	TOTAL ENROLLMENT	REPRESENTATION				
				INSTITUTIONS	STATE & LOCAL	INDUSTRIAL	FEDERAL AGENCIES	FOREIGN COUNTRIES
Feb. 16-27	10	Advanced Course - Radiological Health & Occupational Radiation Protection	12		8	1	2	1
Feb. 18-20	3	Short Course in Phenol Determinations	7		1	6		
Mar.2-13	10	Advanced Training for Sanitary Engineers in Water Pollution Abatement Programs	22		12	7	2	1
April 20-May 1	10	Basic Radiological Health Training	22	1	9	2	9	1
May 4-8	5	Aquatic Biology Training	14		9	3	2	
May 4-15	10	Intermediate Course - Radiological Health	9		4	5		
May 20-22	3	Short Course in Analysis of Metals in Industrial Waste	6		2	3	1	
May 29-30	2	Short Course in Fluoride Analysis	15		14		1	
June 9-11	3	Household Sewage Disposal Systems	17		10		6	1
		Totals	317	26	137	66	76	12

In the field, assistance was given to official state agencies, generally health departments, in organizing and conducting 28 training courses pertaining to environmental sanitation and radiological health. A total of 2642 trainee days was involved in these courses sponsored by the following States: California, Colorado, Florida, Illinois, Michigan, Minnesota, North Carolina, Ohio, Oregon, Pennsylvania, South Dakota, Texas, Virginia, Washington, and Wisconsin.

Conferences and short courses of instruction were arranged for 24 foreign engineers, doctors, and scientists from 14 foreign countries, who spent a total of 125 days at the Center.

Two direct aids to the training program developed during the year deserve particular mention. The "Radiological Health Handbook" was revised in September, 1952. Demands for the handbook rapidly depleted the supply. Another revision was made in March, 1953. Approximately 1500 copies have been distributed and a third revision isanticipated. A model nuclear reactor was prepared which demonstrates the detection, moderation, and activation potentials of neutrons. The model includes a radium-beryllium neutron source, wherein fast neutrons are moderated to thermal energies, making possible neutron detection with a boron trifluoride counter, and permitting the production of detectable amounts of radioisotopes.

There were continued requests for the display and demonstration of the mobile radiological laboratory unit. It was demonstrated at 7 locations throughout the country during the year.

A series of nine symposia was presented by various Sections and Branches of the Center broadly describing the problems and work in

their respective fields. There was an average attendance of 22 persons at each session. Seven seminars were conducted on various research projects.

APPENDIX

PUBLICATIONS AND SPECIAL REPORTS

Methodology

Iodine as a Bactericide. Cecil W. Chambers, Paul W. Kabler, George Malaney and Alton Bryant. Soap and Sanitary Chemicals, 28:149 (October 1952).

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